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ABSTRACT

This project, an example of teacher action research awarded an SCRE Practitioner Award in 2002, considers a program for nursery staff development based around the number and mathematical strands contained in the Knowledge and Understanding section of "A Curriculum Framework for Children 3 to 5". This work was part of the Nursery's Development Plan. It involved looking at resources, reflection upon current practice, staff development work, and consideration of what children were learning in the Nursery. Staff also wanted to apply the findings of other researchers to their practice and took particular inspiration from two early education support documents from the Scottish Consultative Council on the Curriculum (now Learning and Teaching Scotland): (1) "Numeracy Counts"; and (2) "Numeracy in the Early Years: What the Research Tells Us". (Author/NB)

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Promoting Number and Mathematical Development in Nursery through Staff Development

Susan Morton

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Spotlight 88 . UNIVERSITY of GLASGOW

Promoting number and mathematical development in nursery through staff development

Susan Morton, Donibristle Primary School, Fife

This project, an example of teacher action research awarded a SCRE Practitioner Award in 2002, considers a programme of nursery staff-development based around the number and mathematical strands contained in the 'Knowledge and Understanding' section of A Curriculum Framework for Children 3 to 5. *This work was part of the Nursery's Development Plan. It involved looking at resources, reflection upon current practice, staff development work and consideration of what the children were learning in the Nursery. Staff also wanted to apply the findings of other researchers to their practice, and took particular inspiration from two 'Early Education Support' documents from the Scottish Consultative Council on the Curriculum (now Learning and Teaching Scotland):* Numeracy Counts *and* Numeracy in the Early Years. What the Research Tells Us *(Caddell, 1998a; 1998b).*

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BACKGROUND TO THE PROJECT

This work was carried out in Donibristle Nursery, Dalgety Bay, Fife, over part of school years 2000/1 and 2001/2. The Nursery, within Donibristle Primary School, offers part-time places for ante-pre-school children and pre-school children. A handful of pre-school children have full-time places. The staff comprises an Assistant Head Teacher whose remit is Nursery and Primary One, two teachers, three full-time nursery nurses and four job-share nursery nurses. There is a weekly staff development time when all Nursery staff and the Assistant Head Teacher meet together. It was during these meetings that the staff development work was undertaken.

Aims of project

- Raising awareness amongst Nursery staff of how children acquire number and mathematical concepts
- Improving our delivery of the 'Knowledge and Understanding' strands of *A Curriculum Framework for Children 3 to 5*, particularly those strands relating to number and mathematics
- Encouraging children's abilities in, and understanding of, number and mathematics.

The *role of the teacher* in leading this project was a crucial one, as indicated by Caddell (1998a):

> - The teacher's role is crucial in enhancing mathematical knowledge. The crucial and complex role of the adult in managing both the learner and the learning is underlined.
> - The need for teachers to reassess the role they play is emphasised.
> - There is a need for pre-school settings to offer activities to promote early numeracy skills to the same extent as early literacy skills.
>
> (Caddell, 1998a, p.18)

THE START OF THE PROJECT

Information from *Stepping Stones* (Fife Council's Early Intervention project), handouts on 'emergent number and mathematics' from previous in-service training, and other relevant information resources, were gathered for critical evaluation by staff.

- It was important to discuss where we were; to identify what resources we had; and to discuss what should be done next.
- Ideas for spatial awareness, measurement, beginnings of number, shape identifications, and problem solving, were noted; and our current resources were listed.

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- It was agreed that we would compile a resource bank of all these different handouts and place a copy in each provision.

It was felt that number and mathematical activities amongst the children *were* being promoted, but it was also agreed that a more critical assessment, both of current practice and *why* this was practice, should be undertaken during session. Staff agreed to familiarise themselves with a 'Stepping Stones' support booklet *Number is Fun* (Fife Council, n.d.) and to try out some of the ideas and strategies in our resource folder.

Strategies

Strategies suggested by researchers were:

- The importance of communication, both as a means of analysing children's thinking, and as a means of developing their understanding
- The importance of knowledge and understanding of what we are trying to do with the children
- The importance of working with peers, sharing ideas with colleagues and reaching a common ground.

The research process

It was decided to ensure that some counting-out activity was involved at least once a week in the snack area, and that a staff member would try to observe and support this. A choice of fruit – one apple, one pear or one banana – was normal. There was not much counting involved in that, so choices became more demanding of the children, eg 2 plums, 8 grapes or 1 apple. Most children recognised '1' and '2'. Some knew '8', but few could count out 2 plums, let alone 8 grapes. Those who could count out 8 were very supportive of those who could not. As the weeks went on, the children were more confident about counting out at snack time. They were coping with having 2 of one thing and 4 of another. Some of them loved to count, and were helping others count.

This has been an easy way of introducing number in a meaningful way to children, and had highlighted to us children who can recognise the symbols but cannot count that number out, as well as children who cannot recognise the symbol but can count out the quantity. Observations showed that some children recognised numeric symbols *before* they knew the quantity, just as the research suggested (Cadell, 1998a: p.19). Observations of the children in this context had thus become very focused.

By November, staff felt the profile of numeracy and maths had been raised considerably, but there was not much *evidence* of this, except in the activities planned specifically to enhance particular skills, such as counting or sorting a set of graded, coloured boxes put out for children to play with. These proved to be great favourites with the children, and proved useful in eliciting comparative language during play: they stacked them one on top of the other; they tried to balance them; they were continually hiding things inside a box then hiding that box inside other boxes; they played guessing games with them. Adult and peer involvement arose quite naturally, and, again, it seemed easy to use mathematical language in context with the children, and they seemed to understand its use.

METHODS OF INVESTIGATION

Numeracy Counts (Caddell, 1998b) provided the framework to take the next step in our staff development. Six activities were selected from it for staff to work together on, in groups of two or three. These activities highlighted

- How we gather mathematical knowledge of our children
- Counting
- Playing games
- Nursery routines and mathematical experiences
- Observations of children engaged in mathematical activities; and
- Some points to consider, ranging from the use of resources to whether an observational framework could be devised to identify mathematical engagement.

The importance of each type of activity was substantiated by research evidence. Pages from *Numeracy in the Early Years: What the research tells us* were copied for the staff, and their attention was drawn to additional pages from *Numeracy Counts*.

Two weeks of staff development time were given to these activities. Staff were interested in the research findings as some of these reaffirmed what we had been discovering. The importance of playing games as a way of teaching and/or introducing mathematical ideas rather than social development was one which struck everyone as new. Many ideas for enhancing the activities were reported back. These were summarised and placed into our 'Number and Maths Resources' folders. It was agreed that we would review our progress further the following April.

In the January–March term we took a critical look at our weekly planning over a four week period. How had planning impacted upon recordings in the 'Daily Diary' with specific regard to number and maths? Throughout these four weeks we highlighted, in the weekly plans:

- naming of blocks
- numbers at snack time
- numbers in the environment
- number games on the computer
- a 'cake' game – involving dice – which was played to encourage turn taking
- measuring activities in the block area; and
- a bird count.

In the diary there was scarcely a mention of anything remotely mathematical in our recordings of the children's activities. Some mention of them enjoying playing games had been made, as had mention of them persevering with making things and listening to advice given to them. The children were doing a lot of measuring in nursery, so ap-

propriate props for this play were added. This was very salutary, but change takes time; it was felt that the profile of number and maths was being raised, yet there still seemed to be no concrete *evidence* of this.

Over the four week period, key-worker planned activities for 'homebase time' (a set time during each session when the children are in groups with staff, having stories, chatting, singing, etc) did not include much numeracy or maths either. No doubt numeracy and maths were happening, but there was no written evidence of this in planning.

Looking at the children's individual profiles was not much more encouraging. There were a few more entries for number and maths. However, the absence of such entries does not mean that developing numeracy and mathematical skills was not happening. The staff said they felt more confident about what they were looking for and were more confident about how they could extend children's experiences.

Closer observation

It seemed skills in *recording* numeracy and mathematical incidents were needing to be refined, and skills for holding number and/or mathematical discussions with children needed to be improved. With this in mind six children (four pre-school and two ante-pre-school) were observed more closely for four weeks during April–May.

Looking over the observations of these children it was astonishing what was learnt about their number and mathematical knowledge. Some number or maths task was undertaken at homebase time each day: a counting activity, or a story using comparative language or the days of the week – nothing elaborate. It was learnt who could count, who needed support, who did not see that 'counting' related to an object. Children who knew the months of the year were discovered, as were two children who could count how many were in their group and could add on several more children or take some children away. Not much of this information was being recorded in the children's profiles.

Watching these children had led to observing areas more closely, and again it was staggering what was learnt about children's number and mathematical abilities. At the jigsaw table, talk and discussion about positional relations (eg 'alongside', 'underneath'), colours, and shapes occurred naturally. Children could be probed as to why they had placed a bit 'there'. Whilst watering the plants we discussed why some plants were up high, why some had big pots, the shapes of plants. Outside play also produced much comparative and positional language, as did gym activities. A baking activity showed one child who could 'read' the scales. (He said he liked hundreds.) Weighing and mixing gave opportunities to practise mathematical vocabulary, naturally and in context. Block play produced problem-solving as children selected and manoeuvred blocks to build. It also produced supportive action from children helping each other out.

Tadpoles hid *underneath*, swam *over*, things. They changed shape each day. The home corner produced cooks, measuring with spoonfuls. The writing area produced numbers and invitations to parties with times and places on them. A child produced iconic representation of numerals. (What was puzzling was that this child could recognise numerals; so why was she drawing her own version of numbers?) The language children use in play is often mathematical – you sit 'opposite'; Luke Skywalker journeying into 'infinity'; talk about ages and being 'bigger', 'older'.

The computer was interesting too: some children who have mastered the use of the mouse are able to play games easily, while others who may have the understanding of what is being asked of them cannot do it because they don't really understand the use of the mouse. Others find that too much is being asked of them – to master a mouse *and* to do a task. However, one does see a great deal of social interaction and children helping each other at the computer. Children seem highly motivated to learn how to use it, and to learn how to play the games. Supportive intervention may help them develop thinking skills here.

When all of these issues were raised at our end of session discussion times, other staff had similar contributions to make. It is, perhaps, strange that prompting was needed to raise these major issues: is too much importance attached to behaviour and to concerns such as the use of areas rather than considering the learning we are seeing? Staff reactions to this suggestion included:

- Behaviour can affect all that is happening in Nursery.
- The use of areas is important as it shows what children are doing.
- Our focusing on children, and our more specific observations of children, tell us what we need to know about children's development.

Is it, then, the *recording* and/or the *assessment* of the learning we are seeing that are the real difficulties? Baseline assessments of pre-school children in number, and mathematical and literacy skills were happening at this time too. These were rather formal tasks: children were asked to sort, match, name shapes, count by rote. Again much was found out about the children, but very little of this was in the context of their normal play environment.

Reviewing progress

At the end of the four-week focused observations, there was evidence that numeracy and mathematical skills were being promoted. Focusing on practice and consideration of enhancing understanding were producing results.

The April review was looming, and *Numeracy in the Early Years: What the research tells us* was consulted once more. To help us to consolidate and move forward, the following were considered:

- evidence that numeracy and mathematics were not being promoted in pre-school settings
- findings from research into numeracy; and
- strategies to help us move forward in promoting numeracy.

At the review it was agreed that

- Observations in profiles were not the only way to assess how an aspect of the curriculum was being delivered.

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- It was felt that more number games were being played with children and that questioning of children whilst playing games was more mathematics- and number-oriented.
- The counting out activities at snack time had raised awareness of children's counting strategies.
- Staff had more understanding of the learning and concepts involved in early number and mathematics, but they were still needing to address issues of when to intervene, when to observe, and what to record.
- One of the nursery nurses suggested we ask for input from the *Stepping Stones* team at one of our in-service days next session, to further raise awareness of research and current thinking in number and mathematics. Others thought this was a positive step to take.

MAIN FINDINGS

The project and staff development

- The aim of raising awareness amongst nursery staff of children's abilities in number and mathematics has been met. Using some of the findings in *Numeracy Counts* (Caddell, 1998b) helped us focus on certain activities, and gave us the underlying theoretical knowledge.
- Being aware of the research background has given staff greater enjoyment in what the *children* are doing, and increased staff confidence in what *they* are doing.
- Working together has also made people more confident and has strengthened the team spirit.
- Delivery of the 'Knowledge and Understanding' strands of *A Curriculum Framework for Children 3 to 5*, particularly those relating to number and mathematics has begun to improve. Simple things like placing counting within the context of snack time; playing games with more attention paid to our questioning; and an understanding that conversing, turn-taking, and responding are mathematical strategies as well as social conventions, have all made a difference to how mathematics and number are being dealt with.
- Encouraging children's abilities in, and understanding of, number and mathematics has also begun. Other issues have been raised: what is recorded about children; how we describe their learning; how we question them. The issue of when *interaction* with the child becomes *interference* on the adult's part is a major concern amongst staff.
- The suggestion that we ask for in-service work from one of the *Stepping Stones* team shows engagement with the project.

Impact on practice

- Staff are more confident now in offering activities to promote early numeracy skills, and we are more secure in our knowledge and understanding of the competencies involved.
- Staff are addressing what we write about children in staff development time next session.
- Staff are writing more observations on children's numeracy and mathematical ability.
- One of the Nursery teachers is looking at the skills and concepts to be added to planning sheets and to the Daily Diary so staff will become more focused upon the children's learning as we discuss and record.
- Staff need to know the resources available to them in order to make the most of these.
- Time needs to be given to staff to look at and discuss these resources.
- Staff want to know more about early numeracy and early mathematics.

Specific observations

- Number and mathematical understanding improved when children's experiences were used as opportunities to advance their knowledge and understanding.
- Skills were improved with repeated opportunities to practise them, eg counting out at snack time, counting each other at homebase time, using positional vocabulary outdoors and in the gym.
- When we showed children that we used numbers either in talking and/or in writing they copied us.

CONCLUSIONS

- A sound start has been made to raising the profile of number and mathematics – Fraser *et al* (2001: p.2) found, in their evaluation of the Early Intervention programme, that 'Numeracy intervention took much longer to become established over the three year period than literacy'.
- The importance of communicating and listening to what the children are telling us: children should be encouraged to talk both with staff and with each other.

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